with descriptions, &c.—Growe, N. Vibe, and Aubert, Southern Norway, 7 sheets; A. Vibe, ditto, 6 sheets; Schie, ditto, 4 sheets; A. Vibe, Northern Norway, 12 sheets. Total, 45 sheets.

11. Of the above mentioned later maps, and especially of the charts of the coast, many have been published in new and corrected editions. Altogether a number of 20,100 copies have been sold; viz., 3540 maps of districts, 1100 maps by Munch, and 15,460 charts of the coast; and in the office are still in store about 12,000 copies.

12. The fishing-banks and the "Sea-bridge" have been surveyed, and the manuscript records, accompanied by illustrating charts, are preserved in the archives of the office.

13. The measurement of degrees in Finmark is completed, and its results published.

14. The results of the chronometric expedition have likewise been published. During late years the office has received a very considerable collection of printed foreign charts, especially hydrographical. These have chiefly been presented by Government, or by the Geographical Societies of Sweden, Denmark, England, Russia, France, the United States of America, &c.

---

3. *The Federal Map of Switzerland.* Communicated by PROF. PAUL CHAIX of Geneva, Corresponding Member R.G.S.

THE origin of this great work is due to the triangulation of the western part of Switzerland, undertaken at the end of last century, by M. Tralles, of Berne, for the special purpose of determining systematic laws of refraction from the different altitudes of the mountain summits. About the same time M. Feer, the astronomer at Zürich, with the assistance of M. Pestalozzi, drew from a base line measured on the banks of the river Sihl, near Zürich, a series of triangles to the shores of the Lake of Constance; a great number of their signal stations have, however, been destroyed, and there are no means of finding their sites. In 1811 Professor Trechsel was commissioned by the Government of Berne to triangulate the southern part of that canton, resting upon the base measured at Aarberg by M. Tralles. This work was completed in 1816, and has been revised and embodied in the general triangulation of Switzerland. In 1822 a survey of part of the district of Sargans on the eastern frontier was made and submitted to the Federal Government, which was then deliberating upon the execution of the great topographical map of the Confederation. The work having been decided upon, its execution was entrusted to Quartermaster-general Finsler, who preserved the general management till 1828, when he was succeeded by General Würstenberg, who carried it on till 1833, being in his turn succeeded by Colonel, now General Dufour, by whom it is now being completed.

The map is designed on the scale of $\frac{1}{100000}$ of nature, constructed on Flamsteed's modified projection, and to be completed in twenty-five sheets, each sheet being seventy centimetres long and forty-eight centimetres broad, corresponding to an area of 70,000 metres by 48,000.

Two base lines were measured by M. Tralles, with the assistance of M. Hassle, of Aarau, one near Aarberg, and the other near Thoune; the former was measured twice, once in 1791 and again in 1797, both measurements giving a length of 40,188·5 French feet, and differing from each other by only one-fifth of a foot. In 1832 it was remeasured, owing to a difference of $\frac{1}{3305}$ being discovered between the sides of triangles connected with it from a short base measured by M. Feer, near Zürich; this difference was found to be due to

the standards employed. This last measurement, effected by means of tubular iron rods, which had been submitted to the closest examination and experiments with regard to their dilatation under various temperatures, gave a result of 13,053·74 metres or 40,185·208 French feet. The base measured by M. Feer in the Sihlfeld, near Zürich, having been reached by 14 triangles based on the new measure of the base at Aarberg, was calculated to be 3,360·256 metres, while an actual new measure gave 3,359·930. The connection of the triangulation with those of other countries offers a convincing proof of the accuracy of the Swiss measurements. The length of the side Rœmel to Faux d'Enson was calculated by the French engineers as 35,997·22 metres, while the Swiss triangulation makes it 35,997·27 metres. The side Pizzo Forno to Pizzo Menone di Gino was found by the Austrian Staff to be 44,572·77 metres, and by the Swiss 44,572·12.

The number of primordial triangles is 110; 14 of the stations are more than 3000 metres above the level of the sea, 22 from 2500 to 3000, and 15 from 2000 to 2500 metres. The number of triangles of secondary order was 443 in 1840, but has been greatly increased since. With some of them it has been found impossible to observe the three angles owing to the inaccessible nature of one of them, and the consequent impossibility of establishing signals and stations on those points. Most of the highest summits in Switzerland are included in this class, thus giving a peculiar interest to the hypsometrical results of the secondary triangles.

The latitude of the Observatory at Berne, as determined in 1812 by MM. Henry and Delcross, of the French Geographical Engineers, and by Prof. Trechsel, by 382 observations of zenith distances of the Polar Star, was 46° 57′ 8·63″, but by a trigonometrical connection of Berne with Paris made by the French Engineers it was fixed at 46° 57′ 6·02″. The last has been adopted by MM. Dufour and Eschmann on account of its coincidence with the position arrived at from their comparison of the latitudes of Zürich and Geneva, as determined by MM. Eschmann and Alfred Gautier. For the same reason the longitude of Berne has been adopted as it was determined by the French triangulations, viz., 5° 6′ 10·8″ E. of Paris.

The heights above the level of the sea have been determined by a comparison of the Mt. Chasseral in the Jura, as given by the French measurement, and its altitude above the level of the base at Aarberg. Care has been taken not to attempt the measurement of inaccessible points except by comparison with other points placed in about the same circumstances. Angles and observations taken from points much inferior in height and placed at a short distance are of less value than those taken from more distant stations, as the summits being generally rounded at the top are more in evidence at the greater distance. Snowy crests are, besides, subjected to variations in height of perhaps seven metres, owing to the melting or evaporation of the snow. It will never be possible to determine exactly the height of Mont Blanc. According to the measurements of the Sardinian engineers from Mont Colombier, with the factor 0·078 for refraction, its altitude is 4799·70 metres, and from Mont Granier, with the factor 0·076, it is 4,804·03: by M. Puissant in the 'Nouvelle Description Géométrique de la France,' it is stated to be 4808·32. The Swiss measurements have given the following results: from the Moleson, with the factor 0·080, it is 4,801·9; from the Signal de Bougy, with the factor 0·075, it is 4,803·0; and from the same station, with the factor 0·080, it is 4797·8 metres. The very great attention paid to these observations may lead to a better knowledge of the laws of refraction and a better determination of the heights of mountains.

General Dufour has adopted a mixed method of representing the ground, viz., the vertical light with moderate proportions of shading for the relatively flat and undulating tracts, and the old system of oblique light under an angle

of 45° for the upper truly mountainous regions, where the former method would have made the map illegible. The slopes are represented in the original drawings by the projection of horizontal curves designed to have a difference of level of 10 and 30 metres, according to the scale of $\frac{1}{10000}$ or $\frac{1}{100000}$, from each other. These drawings are then given to the practical limners and engravers, who apply to their translation determined rules of shading.

The execution of this work has been attended by great difficulties, owing both to the nature of the country to be surveyed and the limited means placed at the disposal of the engineers by the Government. In 1832 lightning struck the tent of M. Buchwalder on the top of Mt. Sentis in Appenzell, killing Gobat his assistant, and disabling M. Buchwalder himself for the remainder of the campaign. More recently M. Landsmann was precipitated from a cliff in the Grisons and killed. M. Eschmann ascribes several errors in his measurements to the fact that the accuracy of the level he used might sometimes be altered by the neighbourhood of large mountain masses, and he thought that the freezing of the ground on which the instruments had been left during the night might have altered their position. The engineers are during the summer for months together engaged in conducting their operations at heights of many thousand feet above the level of the sea.

In many mountainous districts, where the engineers most required the assistance of the people to overcome physical difficulties of every kind, the ignorant inhabitants were so much averse to having their own country surveyed, that they at first destroyed the signal stations and scarcely allowed the engineers to proceed with their work. Some of the cantons have, however, been prevailed upon to have the survey of their districts made on a larger scale, so that the results have only to be reduced to the scale of $\frac{1}{100000}$ for the purposes of the map. In such case, when the canton has no private staff of its own, the work is executed by the Federal engineers, one-third of the expense being defrayed from the funds allowed to the Federal Survey and the remainder by the Cantonal Government.

---

4. *Sketch of Hilly Daghestan, with the Lesghi Tribes of the Eastern Chain of the Caucasus.* By BARON DE BODE.

Communicated by THOMAS HODGKIN, M.D., &c.

Read, March 26, 1860.

IF you take up a map of the Caucasus, you will find that, bordering on the western shores of the Caspian, are the territories of the Shamál of Terki and the possessions of the Kazi-Kámúks and Mehti-Kúli tribes.* They all lie east of the highlands with which we have now to deal, which extend to the north of the great chain. Unlike the other alpine regions of the Caucasus, split into hill and dale, with spurs and offshoots from the principal snowy range, Daghestan† offers a singular aspect of stupendous granite masses, forming a high table-land, intersected by rapid streams, the three Kòï-sus,‡ with their respective tributaries, embedded in deep ravines whose steep walls descend terrace-like to the water's edge. The greater part of these granite hills are void of vegetation, and look wild and dreary.

Agriculture is in a most deplorable state. You may often see some hardy

* These districts lie between Derbend and the Terek. *See* Monteith's map of Georgia.—J. S.

† Daghestan has been generally considered as mountainous with very narrow valleys.—J. S.

‡ Turkish words—Kioï, a village, soo, water.—J. S.